

## CLAIMS

1. An apparatus for storing and delivering a low vapor pressure process chemical to a process tool for semiconductor fabrication, comprising:

a) a bulk container for storing said low vapor pressure process chemical;

5 b) a process container for delivering said low vapor pressure process chemical to said process tool;

c) a first manifold for resupplying said low vapor pressure process chemical from said bulk container to said process container through one or more diaphragm valves having the valve seat side of the valve directed to the portion of the manifold which can  
10 be disconnected from the bulk container;

d) a solvent container containing a quantity of solvent for the low vapor pressure process chemical and connected in fluid flow with said first manifold;

e) a second manifold for delivering said low vapor pressure process chemical from said process container to said process tool through one or more diaphragm valves  
15 having the valve seat side of the valve directed to the portion of the manifold which can be disconnected from the first manifold;

f) a source of vacuum;

g) a source of pressurized inert gas;

h) a controller for controlling the flow of process chemical from said bulk container  
20 and from said process container and the flow of solvent from said solvent container and for cycling the first and second manifolds through a cleaning cycle of a series of applications of vacuum, pressurizing gas and solvent to clean said manifolds.

2. The apparatus of Claim 1 wherein said first and second manifolds are connected  
25 and are further connected to a source of venting.

3. The apparatus of Claim 1 wherein solvent lines are connected to said solvent container and the process tool to flow solvent to the process tool.

4. The apparatus of Claim 3 wherein said flow of solvent to said process tool is  
5 returned in the second manifold.

5. The apparatus of Claim 1 wherein a solvent recovery container is connected to said first and second manifolds to recover solvent flowing through said manifolds from said solvent container.

6. The apparatus of Claim 1 wherein said solvent container is connected in fluid flow with said second manifold.

7. The apparatus of Claim 1 wherein said first manifold has an ultrasonic liquid  
15 sensor to detect any solvent in said manifold.

8. The apparatus of Claim 1 wherein said first manifold has an ultrasonic liquid sensor to determine when the bulk container is empty.

20 9. The apparatus of Claim 1 wherein said first manifold has a source of trickle purge of inert gas to avoid atmospheric exposure of said process chemical and said manifold.

10. The apparatus of Claim 1 wherein said low vapor pressure process chemical is selected from the group consisting of tetradimethylaminotitanium (TDMAT),  
25 tetradiethylaminotitanium (TDEAT), tantalum pentaethoxide (TAETO),  $\text{TiCl}_4$ , copper perfluoroacetylacetonate-trimethylvinylsilane and mixtures thereof.

11. A process of storing and delivering a low vapor pressure process chemical to a process tool for semiconductor fabrication, comprising:

5 a) providing a quantity of said low vapor pressure process chemical in a bulk container;

b) periodically delivering said low vapor pressure process chemical to a process container from said bulk container through a first manifold having one or more diaphragm valves having the valve seat side of the valve directed to the portion of the manifold which can be disconnected from the bulk container;

10 c) periodically delivering said low vapor pressure process chemical to a process tool from said process container through a second manifold having one or more diaphragm valves having the valve seat side of the valve directed to the portion of the manifold which can be disconnected from the process container;

15 d) providing a quantity of solvent for said low vapor pressure process chemical in a solvent container;

e) periodically delivering said solvent to said first or second manifold when said low vapor pressure process chemical is not being delivered to said first or second manifold to remove said low vapor pressure process chemical from said manifold and storing it in a solvent recovery container.

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12. The process of Claim 11 wherein a sequence of vacuum and pressurizing gas are applied to said first manifold prior to delivering said solvent to said first manifold.

13. The process of Claim 11 wherein a sequence of vacuum and pressurizing gas  
25 are applied to said second manifold prior to delivering said solvent to second manifold.

14. The process of Claim 12 wherein the first manifold is vented prior to the sequence of vacuum and pressurizing gas.

15. The process of Claim 13 wherein the second manifold is vented prior to the  
5 sequence of vacuum and pressurizing gas.

16. The process of Claim 12 wherein said pressurizing gas provides the force for delivering said low vapor pressure process chemical to said process container from said bulk container through said first manifold by contacting said pressurizing gas with an inlet  
10 valve of said bulk container and wherein said solvent does not contact said inlet valve.

17. The process of Claim 11 wherein process chemical is detected in said first manifold by an ultrasonic liquid sensor.

18. The process of Claim 11 wherein said first manifold has a source of trickle purge  
15 of inert gas flowing through it to avoid atmospheric exposure of said process chemical and said manifold.

19. The process of Claim 11 wherein said low vapor pressure process chemical is  
20 selected from the group consisting of tetradimethylaminotitanium (TDMAT), tetradiethylaminotitanium (TDEAT), tantalum pentaethoxide (TAETO),  $\text{TiCl}_4$ , copper perfluoroacetylacetonate-trimethylvinylsilane and mixtures thereof.

20. A process of storing and delivering a low vapor pressure process chemical to a  
25 process tool for semiconductor fabrication, comprising:

a) providing a quantity of said low vapor pressure process chemical in a bulk container;

b) periodically delivering said low vapor pressure process chemical to a process container from said bulk container through a first manifold having one or more diaphragm valves having a valve seat side of said valve directed to the portion of said first manifold which can be disconnected from the bulk container;

c) periodically delivering said low vapor pressure process chemical to a process tool from said process container through a second manifold having one or more diaphragm valves having the valve seat side of the valve directed to the portion of the manifold which can be disconnected from the process container;

d) removing residual process chemical from said first manifold to a solvent recovery container by at least one application of a pressurizing gas to said first manifold;

e) providing a sequence of vacuum and pressurizing gas to said first manifold;

f) providing a quantity of solvent for said low vapor pressure process chemical in a solvent container;

g) periodically delivering said solvent to said first manifold when said low vapor pressure process chemical is not being delivered to said first manifold to remove said low vapor pressure process chemical from said manifold and storing it in said solvent recovery container;

g) disconnecting said bulk container from said first manifold and replacing it with another bulk container containing said low vapor pressure process chemical.

21. In a process of storing and delivering through a manifold a low vapor pressure process chemical to a process tool for semiconductor fabrication, the improvement comprising the steps of receiving and storing residual process chemical from said manifold and solvent used to remove said process chemical from said manifold and

separating said solvent from said process chemical by evaporating said solvent from said process chemical, such evaporation effected by a step selected from the group consisting of: an entraining gas passed through the solvent, the application of heat to said solvent, the application of vacuum to said solvent and combinations thereof.

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